The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Fuel Research

THE Annual Reports of the Fuel Research Board are assuming each year increasing interest to the chemist. The tendency is for coal to be considered as a source of carbon and therefore as being the starting point for a series of chemical reactions leading to the production of gas, of oils, of lubricants, of alcohols, and of other chemical products.

An interesting conclusion that can be drawn from the Report of Sir Harold Hartley upon the carbonisation policy of the Board during the last seven years is that the gas engineer is becoming increasingly a chemical engineer. If the developments foreshadowed in the present Report continue to be followed up, as we know they are being followed up, the manufacture of gas will become the province of the chemical engineer. In the endeavour to increase the flexibility of the gas-making process so as to allow coke or gas to be made at will, the fuel chemist is making increasing use of the reactions between carbon monoxide and hydrogen. In the presence of suitable catalysts, at a temperature of about 200° C., and under pressures of the order of atmospheric these gases in the proportion $CO + 2H_2$ combine to form a series of paraffinic and olefinic oils by a reaction which is now associated with the names of Fischer and Tropsch. Again in the presence of suitable catalysts, and at temperatures near 300° C., a mixture of the composition $CO + 3H_2$, or containing more hydrogen than this, produces methane, and since this reaction is accompanied by an evolution of heat and a diminution of gas volume, it is favoured by the use of low temperatures and a high pressure. Even at atmospheric pressure, however, it still proceeds in the direction $CO + 3H_2 = CH_4 + H_2O$, in the presence of suitable catalysts such as cobalt, thoria, or kieselguhr. With other catalysts at 350-400° C. and under high pressures of the order of 200-600 atm. the mixture $CO + 2H_2$ forms methyl alcohol. When coal is carbonised in the presence of hydrogen and at a pressure of 50 atm. interaction between hydrogen, carbon and the nascent compounds evolved from the coal produces a very high yield of gas rich in methane. When the coke is used for producing the necessary hydrogen from steam, the process becomes one of complete gasification. The potentialities of these processes are obvious for the production of fuel oils, of town-gas by complete gasification, and of lubricating oils through the polymerisation of olefines. It is evident that if the gas industry is to develop on these lines, as indeed seems very likely, the chemical engineer will take his place in the gas works, and will supplant the gas engineer for the production of gas. The production engineer will have to control the production of water gas, the formation from that of the correct CO/H_2 mixture and finally the maintenance of the catalyst and the correct conditions for the particular reaction desired.

The tar distiller will be interested in the observation contained in the Report that coal-tar pitch is far more susceptible to hydrogenation than had been suspected. Horizontal-retort tar seems to contain a good deal of refractory material which resists hydrogenation. This tar is, of course, comparatively high in "free carbon" content. A coke-oven tar yielded no less than 92.4 per cent. by weight of oil lighter in specific gravity than water and containing only 0.2 per cent. free carbon and 1.8 per cent. asphalt; the residue boiling above 360° C. amounted to only 15.6 per cent. by weight of the original tar. The most remarkable feature of the results was the great reduction in asphaltic material; evidently coke-oven tar, if the sample tested may be taken as representative, contains a very much smaller proportion of refractory material than does horizontal-retort tar.

Oil from coal bulks largely in the work of the Board, and work is being continued on the hydrogenation of coal. It is found that under the mildest conditions of temperature and hydrogen pressure, a solid product is obtained in which the coking properties have been increased; would this lead the way to a possible new carbonisation process in which the less highly-coking coals were carbonised under pressure and in presence of hydrogen? The primary objective of the work on coal hydrogenation is to survey the hydrogenation possibilities of the coals of the country. It has recently been announced in Parliament that the Government has received a valuable report on the Fischer-Tropsch and similar synthetic processes for producing oil from coal from a Committee appointed for the purpose. It may well be asked why it is necessary 15 months after the outbreak of war to receive reports from Committees, when a pilot plant could have been erected before the war in which we should have had the full benefit of Professor Fischer's researches. This step was urged by many industrialists, but the British Government of the day turned a deaf ear. Now the Fuel Research Board finds it necessary to experiment on laboratory and semi-works scales to discover facts that are no doubt already the basis of everyday industrial practice in Germany—or were until we blew up their synthetic oil plants. Obviously, however, the Fuel Research Board is primarily interested in the manufacture of lubricating oils from the olefines produced in the synthesis, and a good deal of success is being achieved.

NOTES AND COMMENTS

Social Relations of Science

At the anniversary meeting of the Royal Society, held last Saturday, Sir William Bragg, the retiring president, delivered an address on the Social Relations of Science. Speaking on this problem of social relations, which had compelled the Society to enlarge the range of its work, Sir William mentioned the great opportunity that had been afforded by the creation of the Scientific Advisory Committee in close association with the Cabinet. He hoped that no hindrances from without would interfere with the Society's task; they were determined that there should be no lack of energy from within. It could not be said that the general attitude of the nation towards the increase of knowledge was satisfactory. Science had become an integral part of our educational system, yet the changes that had been made were ridiculously like the casting of sacrifices to following wolves. Science was not a devouring monster, but a means of service, and might be rightly or wrongly used. There was a prime danger if those who were in a position to use it rightly shut their eyes to its presence and power, like an army that relied on bows and arrows when its enemy knew how to use machine-guns. They aimed at arousing a general appreciation of the position, especially in those that had authority and set an example. It was not universally nor even sufficiently understood how important natural knowledge had become. Since experimental science had assumed such a commanding influence on all affairs, we ran the risk of great perils if we took no account of it and left its uses to others less well disposed than ourselves, and it became a first duty to direct our steps accordingly.

Factory Lighting in War Time

Following the publication last July of the fifth report of the departmental committee set up to study the effect of black-out conditions on the lighting of factories, reference to which was made in The Chemical Age at the time, there have now appeared the Factories (Standards of Lighting) Regulations, 1940, prescribing a standard of lighting for factories working more than 48 hours a week or in shifts. The whole purpose of the Regulations is to eliminate strain and fatigue of the workers due to faulty illumination. How great a strain can be caused has been fully realised only during the last few years. The standard of illumination over those interior parts of a factory where persons are regularly employed shall be "not less than 6 foot-candles measured in a horizontal plane at a level of 3 feet from the floor," with certain exceptions. General and local lighting must be so arranged, and so shielded by appropriate fittings, that glare is avoided, and as far as is practicable reflection of light from smooth or polished surfaces into the eyes of the worker must be prevented by suitable screening or positioning of the light sources. The formation of shadows that cause discomfort or risk of accident must also be prevented. In order to comply with the new regulations, many employers will probably be glad to avail themselves of the guidance offered by the National Industrial Electric Lighting Service, behind which is a body of expert knowledge acquired and consolidated through prolonged research and experience in the highways and byways of illuminating science. Sir Duncan Wilson, Chief Inspector of Factories, who was chairman of the departmental committee, is also chairman of the Service, further details of which are obtainable from the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2.

Limitation of Supplies

Careful perusal of the formidable document issued by the Board of Trade and known as the Explanatory Memorandum to the Limitation of Supplies (Miscellaneous) (No. 5) Order, 1940—it runs into nineteen mimeographed and often nearly illegible foolscap pages—leads to the conclusion that the chemical industries are scarcely affected by the Order, their products being rightly considered as "goods vital for the war effort." Certain perfumery and toilet preparations, "other than soap, shaving soap, shaving cream, tooth paste, and tooth powder," listed under Section 16, are subject to a home trade quota of 25 per cent., but even here such materials as fullers' earth, kaolin, and hydrogen peroxide are exempt from the provisions of the Order unless they are specially prepared for toilet use, and what the Order is really concerned with is the restriction of the manufacture (for the home trade) of such adjuncts to beauty as slimming cream and nail varnish (to quote two items in a long list). In various other categories articles affecting the chemical industries are specifically exempted from the terms of the Order, *e.g.*, ferroprussiate, ferrogallic, and dyeline paper and cloth in Section 12 (Photographic Accessories), and laboratory porcelain and refractory tiles in Section 8 (Pottery and Glass). And above all it is pointed out, and even emphasised by a diagram, that the channels between manufacturers and wholesalers registered in the same class, and between both of these categories and their export outlets, remain absolutely unrestricted. It is evidently fully realised that export trade—even in slimming cream and nail varnish—brings life-blood to the country.

Chrome Ore and Chromium

Another new volume * has just been added to the series of monographs on mineral resources issued by the Imperial Institute. It deals in 118 pages with Chrome Ore and Chromium and covers every aspect of the nature, occurrence and utilisation of the mineral, with special reference to Empire deposits. Some measure of the rapidly increasing use of chrome ore may be gathered from the fact that the world's output rose from less than 250,000 tons to more than a million tons during the period between the close of the war of 1914-18 and the outbreak of the present war. Chromium is mainly employed for metallurgical purposes, for example in the modern stainless steels which have so many applications both warlike and pacific, notably in situations where light-weight structures of great strengh are required. There are also the heat-resisting nickel-chrome steels and nickel-chromium resistance alloys so essential for machine-tools, the refractories based on chrome ore, and the dichromates, chromic acid and chromium salts used in the chemical industry. The Empire is very strongly situated in regard to supplies of this strategic mineral, for Southern Rhodesia and the Union of South Africa are among the world's leading producers. India, too, possesses important deposits of chrome ore of good metallurgical grade, and Cyprus and Sierra Leone also contribute to the total output. In fact, just prior to the present war, about one-third of the world's output came from British countries and two-thirds from companies under British control.

* *Chrome Ore and Chromium*, by Robert Allen, M.A., B.Sc., and G. E. Howling, B.Sc. (Imperial Institute, South Kensington, S.W.7. 2s. 6d. net, postage 4d.)

REMOVAL AND RECOVERY OF SULPHUR FROM SMELTER GASES, II

Regeneration Processes

By D. D. HOWAT, B.Sc., A.Inst. M.M., A.I.C., Ph.D.

(Continued from p. 255 "The Chemical Age," November 30th, 1940)

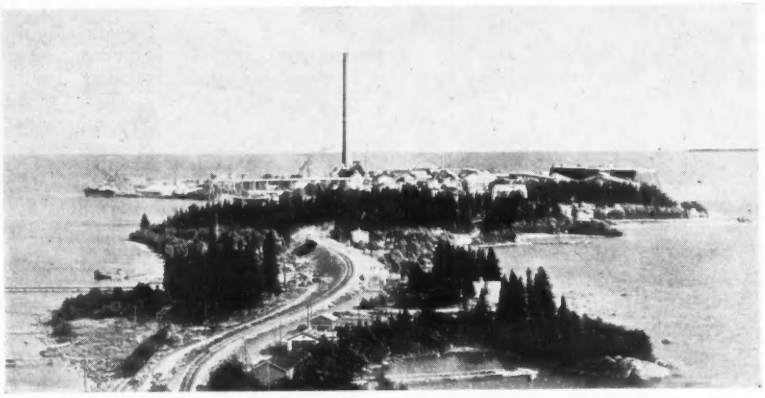

Fig. 5. General view of the sulphur recovery plant of the Boliden Company at Rönnskär, Sweden.

WORK by the U.S. Bureau of Mines [7, 26] has shown that diamino-diethylamine and triethylenetetramine, short-chain aliphatic amines, are good absorbents for sulphur dioxide. Working with absorption and regeneration temperatures of 35° and 90° C. respectively, solutions of diamino-diethylamine, containing 9.75, 18, 26.7 and 35.8 per cent. of the amine, will absorb 84.3, 124, 177 and 207 gms. of sulphur dioxide per litre, the greater part of the gas being evolved on boiling. Johnstone[18] suggests that methylamine is superior to ammonia as an absorbing agent.

The Lurgi Process

This process, devised by Chemische Industrie Basle (Ciba) and operated by Metallgesellschaft A.G., Frankfurt, a.M., employs aqueous solutions of arylamines, particularly xylidine and toluidine, the usual concentration of amine being about 50 per cent. The process appears to have been put into successful operation in Germany.[1] One of the main problems in the process is the removal of the organic base sulphates produced by oxidation. The low solubility of these organic base sulphates causes them to crystallise out, producing thickening of the solution and clogging of pipes and towers so that further operation becomes impossible. From a study of a series of patents granted to Metallgesellschaft A.G.[27] it appears that the earlier developments of the process called for the regular addition of hydroxides and carbonates of the alkali metals to the solutions. These substances decomposed the organic base sulphates, liberating the amine compounds and forming water-soluble inorganic sulphates which dissolved in the aqueous phase of the absorbing solution. It was found, however, that under certain conditions, *e.g.*, with the use of xylidine and toluidine, it was necessary to prevent the formation of the organic base sulphates, particularly during the boiling period.

The presence of elementary sulphur proved to be highly undesirable in the amine absorbents. As indicated already, elementary sulphur may form in the absorbing solution either by autoxidation of the sulphur dioxide, or during the treatment of certain substances, *e.g.*, the calcination of calcium or magnesium sulphates with carbon. Provided that the acidity of the absorbing mixture does not rise above a certain maximum value (equal to the acidity of a solution of the same concentration of the sulphite and bisulphite of the organic base), the sulphur exists as inorganic thiosulphates and polythionates, but if the acidity of the solution rises, thiosulphates and polythionates of the organic base are formed. These compounds break down further to give organic base sulphates and free elementary sulphur, the autoxidation of the sulphur dioxide being progressively accelerated. At the temperature of sulphur dioxide regeneration the organic base sulphates undergo a considerable degree of hydrolytic dissociation. The free sulphuric acid produced by dissociation assists in the decomposition of the thiosulphates to produce still more free sulphur. In this way a "vicious circle" of oxidation effects may be set up.

To guard against this rise in acidity a certain degree of "protective alkalinity" is necessary, and is furnished by the addition of sodium carbonate or hydroxide in amounts sufficient to give 7 gms. of sodium oxide or its equivalent per litre of the aqueous phase. This concentration has been found sufficient to maintain the acidity at a value not greater than that of the mixture of the monosulphites and bisulphites of the organic base.

A further patent [19] claims that the sodium sulphate formed may be removed regularly by cooling the affluent liquor from the absorption towers to 2° C. The excess sulphate crystallises out and the solution is returned to the absorbers after the additions of alkali necessary to maintain the sodium oxide at the predetermined value.

The use of sodium sulphite-bisulphite solutions for the absorption of sulphur dioxide has been discussed in an extensive series of papers by H. F. Johnstone and his colleagues in the University of Illinois [13, 14, 15, 16, 17, 18]. In these the authors discuss the use of the sulphite-bisulphite salts of ammonium, sodium and methylamine, the design of suitable absorbers, quantities of steam required for regeneration, types of regenerators, and finally the development of a chemical process for regeneration of the sulphur dioxide.

Curves for the capacity of the various absorbing solutions are given in Fig. 6. The following deductions are drawn:—

(1) When solutions of sodium sulphite-bisulphite or methylamine are used in preference to ammonia for the cyclic method of recovering sulphur dioxide from dilute gases larger quantities of steam are required for regeneration.

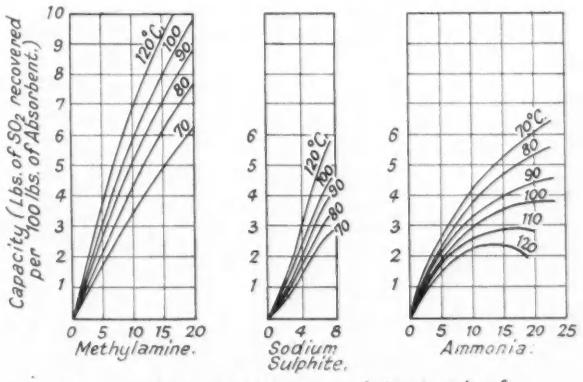

Fig. 6. Absorption and regeneration of sulphur dioxide from solutions of various bases. Temperature of absorption in every case 35°C.; temperatures of regeneration marked on curves (Johnstone and co-workers).

(2) On account of the non-volatility of the sodium and methylamine bases, regeneration may be carried much further and more complete recovery of the sulphur dioxide effected. Regeneration from ammonia solutions is limited by the volatility of the base, and the dilution of the sulphur dioxide by large volumes of steam.

(3) For certain concentrations of ammonia a minimum amount of steam is required for regeneration, thus limiting the concentration of the absorbing agent used. There is no such limit in the case of the sodium or methylamine bases, concentration being limited only by the solubility of the salts.

(4) An increase in the regeneration temperatures increases the capacity of the solutions of the sodium and methylamine bases, but leads to a decrease in the capacity of ammonia. It is thus possible to employ much more efficient stripping of the sulphur dioxide from the sodium and methylamine bases, so that both systems have a relatively greater absorbing capacity than ammonia.

(5) From theoretical calculations it has been shown that solutions with the greatest capacity for the reversible absorption of sulphur dioxide, from gases containing less than 0.5 per cent. of that compound, are those containing sulphites of weak bases having ionisation constants of 10^{-8}, salts of weak acids having ionisation constants of 10^{-6}, or heterogeneous mixtures of solutions of salts of weak acids, saturated with free acid, for which $K_a.K_s=10^{-14}$. These latter solutions are more nearly buffered in the range desired and consequently the vapour pressure curves are more nearly linear.

In the last paper of the series [13] Johnstone and Singh outline a new process, with suggested flow-sheet, for the recovery of sulphur dioxide from waste gases using sulphite-bisulphite sodium salts. A chemical method of regeneration by the use of zinc oxide is put forward, the sulphur dioxide being recovered from the zinc sulphite produced by " flash calcining " in a heated vertical retort furnace. Data are given, derived from a study of the process on a small-scale pilot plant with a capacity of 1000 cu. ft. of flue-gas per minute.

Discussing the chemical method of regeneration, the authors state that sulphur dioxide cannot be recovered satisfactorily from solutions by heating, when gases with a low sulphur content are being treated, and claim the following advantages for the chemical method: (1) owing to the more complete regeneration, faster absorption becomes possible; (2) the employment of practically saturated solutions necessary for economic regeneration by heating is rendered no longer imperative; (3) more complete removal of the sulphur dioxide becomes possible, especially on dilute gases; and (4) losses of absorbing reagents are smaller. The use of zinc oxide as the chemical regenerating agent offers distinct advantages. Zinc sulphite, forming easily and rapidly on the addition of the oxide to the absorbing solution, is decomposed by heating to 260° C., yielding zinc oxide, sulphur dioxide and water vapour, the sulphur dioxide being recovered in a practically pure form from the gaseous phase. The only other metal comparable with zinc in this respect is magnesium, but the decomposition temperature of the sulphite is 650° C. and about 20 per cent. is converted to sulphate. In the case of lime the sulphite is not decomposed until 1050° C., the products being a mixture of sulphide, sulphate and oxide with some free sulphur dioxide.

The suggested flow-sheet for the process is shown in Fig. 7. The waste gases are scrubbed in a suitable tower with the aqueous solutions of the sulphites and bisulphites of sodium. The sulphur dioxide absorbed increases the ratio of bisulphite to sulphite according to the reaction:—

$$SO_2 + SO_3^- + H_2O = 2HSO_3^-$$

After passing through a clarifier in which any solid material is removed, the solution is pumped to a turbo-mixer to which an emulsion of zinc oxide is added. The following reactions occur:—

$$ZnO + NaHSO_3 + 2\tfrac{1}{2}H_2O = ZnSO_3.2\tfrac{1}{2}H_2O + NaOH.$$
$$NaOH + NaHSO_3 = Na_2SO_3 + H_2O.$$

The original ratio of bisulphite to sulphite is restored, about 25 per cent. of the sulphur dioxide in the solution being precipitated as the insoluble zinc sulphite. The mixture is agitated to promote crystal growth and then treated in a continuous drum-filter. Water is added to the filter effluent to compensate for that lost by evaporation in the scrubbers and the alkali content is maintained at the correct value by the addition of soda ash, which of course, is immediately converted to the sulphite. The zinc sulphite cake is sent through a drier and treated in a " flash calciner " heated by indirect heat, the dried sulphite being showered down through the vertical chamber in a fine spray. The hot gases from the combustion chamber of the calciner are used in the drier. The gases from the calcination of the zinc sulphite, containing approximately 40 per cent. water vapour and 60 per cent. sulphur dioxide by weight, are passed through suitable coolers, driers and compressors, from which liquid sulphur dioxide may be obtained in a high state of purity. No carbon dioxide passes into the gaseous products as this compound is not soluble in the absorbing solutions under the conditions employed. The zinc oxide obtained from the calcination process is in the form of a light, fluffy, extremely active material which is sent back directly to the regeneration system.

Any oxidation of the sulphur dioxide in the system results in the formation of zinc sulphate which passes into the absorbing solution, giving a net effect of a decrease in the concentration of the sodium ions available for the formation

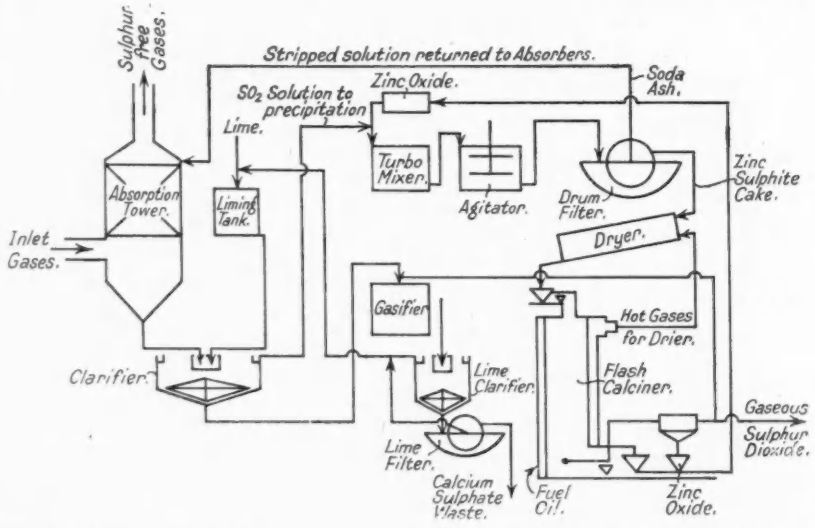

Fig. 7. Suggested flow-sheet for absorption of sulphur dioxide by means of solutions of sodium sulphite and bisulphite, showing arrangement for chemical regeneration of the sulphur dioxide by means of zinc oxide, and treatment of zinc sulphite in flash calciner (Johnstone and co-workers).

of sulphite and bisulphite. The following process has been found reasonably satisfactory for the removal of the soluble sulphates. The correct fraction of solution is withdrawn as a side-stream with the underflow from the clarifier. This underflow contains solid material in the form of ash particles and calcium sulphite, the source of which will be described later. This thin slurry is treated with sufficient sulphur dioxide, obtained from the exit gases from the calciner, to convert all the soluble sulphite to bisulphite. Under these conditions the sulphate precipitates as calcium sulphate. Ash particles present facilitate crystallisation and the two solid phases are removed by means of a continuous filter. The desulphated solution, containing calcium ions, is now treated with lime in sufficient quantities to convert part of the bisulphite to calcium sulphite, this addition restoring the *p*H value of the solution to approximately that of the main stream. The desulphated solution, together with the calcium sulphite in suspension, is returned to the clarifier, forming the source of the calcium sulphite mentioned earlier. The calcium sulphite crystals settle rapidly and assist in removing the fine ash particles from the suspension. The quantity of underflow removed from the clarifier is determined by the amount of sulphate formed per cycle of the solution. The flow-sheet just described was worked out for the treatment of gases containing about 0.5 per cent. of sulphur dioxide, the experimental work being carried out on boiler-flue gases. According to the authors' calculations a plant with a capacity of 100,000 cu. ft. of gas per minute could be constructed for $140,000, say £30,000, this figure including machinery for the liquefaction of the sulphur dioxide. The fixed charges and operating costs are estimated to be about $15½ per ton of sulphur. The loss of chemicals by oxidation, assumed to be about 1 per cent. per cycle, is the largest single item in the costs (about 30 per cent).

Reduction of SO_2 to Elementary Sulphur

Elementary sulphur is undoubtedly the simplest and most convenient form of the element from the point of view of handling, storage and transport. Reduction of the sulphur dioxide to elementary sulphur therefore becomes a matter of considerable importance. Highly concentrated sulphur dioxide, obtained from any of the processes just described, may be reduced by means of coke in a suitable type of producer. Incidentally, the cost of metallurgical coke was the main factor leading to the research and development of processes for concentrating the sulphur dioxide. Only at Rönnskär, Sweden, has a process been developed for the direct reduction of the raw smelter gases.

Different processes for the reduction of sulphur dioxide have been developed by I.C.I., Ltd., in England, Consolidated Mining and Smelting Co. of Canada, Ltd., in Canada, Boliden Mining Company in Sweden, and Metallgesellschaft A.G. in Germany. The four processes are similar in general lines, differing only in certain smaller points of detail. Only scanty information on any of the processes has appeared in technical and scientific journals [1, 12, 3], but a general picture may be put together from a study of the patent literature and any other evidence available.

R. Lepsoe, of the Consolidated Mining and Smelting Co. of Canada, Ltd., has published two papers[2] on the mechanism of the reduction of sulphur dioxide by carbon. His data relate to the reduction of sulphur dioxide by coke in an ordinary standard water-gas producer. He showed that the reduction could be expressed satisfactorily by the consecutive equations :—

$$SO_2 + C = CO_2 + \tfrac{1}{2}S_2 \quad \ldots \quad \ldots \quad (1)$$

$$CO_2 + C = 2CO \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where the ratio of the apparent reaction constants for the reduction of sulphur dioxide and carbon dioxide by carbon was 10 to 1. But as the ratio of the actual observed rates was only 5 to 1, he inferred that a third reaction :—

$$SO_2 + 2CO = 2CO_2 + \tfrac{1}{2}S_2 \quad \ldots \quad \ldots \quad (3)$$

must also take place as a reaction of the first order at the surface of the coke with ash as a catalyst. The reduction of sulphur dioxide by carbon is strongly exothermic, but the heat evolved is not so great as that absorbed in the endothermic reaction (2). However, the speed of reaction (1) is much faster than reaction (2), so that the temperature gradually builds up to a maximum at about 1300° C. when about 80 per cent. of the sulphur dioxide has been reduced. The exit gases from the producer must carry sufficient carbon monoxide to combine with the residual sulphur dioxide in a subsequent catalytic step. In order to provide this required amount of carbon monoxide, and to develop temperature for high reduction rates and smooth operation of the producer, extraneous heat must be added. The simplest method of supplying this heat is to introduce oxygen in the form of air into the producer along with the sulphur dioxide. In the original patent granted to Metallgesellschaft A.G.[6] reduction of sulphur dioxide was carried out by the use of a very shallow bed of coke in the producer, the advantage claimed being that the formation of carbon monoxide was minimised and all the carbon oxidised to carbon dioxide with a consequent increase in the heat efficiency in the producer. The later patent,[6] however, reverts to the use of a deeper bed.

Above 1200° C. the rate of reduction of sulphur dioxide appears to be controlled by the rate at which fresh volumes

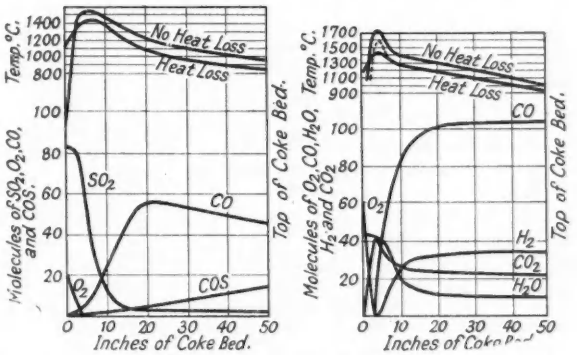

Fig. 8. Curves showing the comparison of sulphur dioxide reduction (8a ; left) with producer-gas operation (8b ; right).

of the gas are able to diffuse through the stationary gas film around each carbon particle. In effect, the rate of diffusion controls the rate of reduction. The producer-gas reaction is controlled by diffusion in exactly the same way at temperatures above 1400° C. Lepsoe shows that the reduction of sulphur dioxide and the normal producer operation show marked similarity, both depending upon the supply of air (oxygen) for heat. Comparing the curves for producer-gas operation and for sulphur dioxide reduction as shown in Figs. 8b and 8a, it may be observed that the former attains a maximum temperature at the point where the oxygen is entirely consumed, whereas with the latter the temperature continues to rise until about 50 per cent. of the sulphur dioxide has been reduced and then falls gradually as the endothermic reduction of carbon dioxide becomes predominant. The very hot zone in the coke bed is only 4 to 6 in. in depth in normal producer-gas operations, while a much deeper hot zone is required in the reduction of sulphur dioxide. In the reduction an exothermic reaction :—

$$CO + \tfrac{1}{2}S_2 = COS \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

resulting in the formation of carbonyl sulphide, occurs in the lower temperature range. This tends to flatten the slope of the temperature curve as shown in Fig. 8a.

The theoretical consumption of carbon per ton of sulphur reduced is 0.44 tons, but the amount of carbon lost in the coke ash and the efficiency of the catalysis make the actual figures much higher. Coal may be substituted for coke as the reducing agent, with the advantages of lower cost and lower ignition temperature, but with the serious disadvantage of the production of copious quantities of hydrogen sulphide, which is much more difficult to reduce to sulphur.

(To be concluded.)

Ceric Sulphate as a Reagent*

Volumetric Estimation of Ferrous and Stannous Salts

CERIC sulphate solution used as a reagent in volumetric analysis has some advantages which are not yet widely known. The oxidation proceeds—

$$2Ce(SO_4)_2 + H_2O \rightarrow Ce_2(SO_4)_3 + H_2SO_4 + O,$$

and there are no side-reactions (contrast potassium permanganate). The cost of the reagent is not excessive. To make a tenth-normal solution, 150 gm. of "technical ceric sulphate" is dissolved in 200 ml. of 10 N sulphuric acid and diluted to one litre. The orange solution is permanent; one constantly used solution, originally 0.1 N, diminished to 0.0994 N in two years, a little precipitate settling out in that time. The highly acid and dense solution makes for clean burettes and for convenience in working; while a blue-line burette containing this solution may be read in the usual way. Moreover, the bulk of the cerium may be readily recovered; a litre of the titrated solutions is heated and about 60 gm. of ammonium oxalate crystals added, and cerium oxalate precipitates. After standing, the precipitate is filtered off, washed and dried and ignited to dark-brown cerium dioxide; 50 gm. of this dioxide and 60 ml. of concentrated sulphuric acid are required to make a litre of N/10 ceric sulphate solution.

Titrations with this reagent are carried out in a strong acid solution. The solution was usually 1 or 2 molar in sulphuric acid at the finish of the titration, and phosphoric acid (up to ½ molar) was usually present. Diphenylamine or N-phenyl anthranilic acid, dissolved in sulphuric acid, are sensitive indicators, the latter giving a deep purple colour at the end-point. The ceric sulphate solution was standardised against ferrous ammonium sulphate of the best quality—using 1 gm. of the latter salt with 5 ml. water, 10 ml. of 10 N sulphuric acid, 2 ml. of concentrated phosphoric acid and one drop of indicator.

Estimation of Iron

The ceric sulphate titration of ferrous salts is easy and accurate under the above conditions. The addition of considerable oxalic, tartaric, or citric acid makes no difference to the result; but with oxalic acid the end-point colour fades in sunlight. Thus 5 ml. of N/10 ferrous solution with 5 ml. of 10 N sulphuric acid and 2 ml. of concentrated phosphoric acid required the same amount of ceric sulphate solution, about 5 ml., in the presence of 20 ml. of N/10 oxalic acid, or of 1 gram of citric or tartaric acid, or of 5 ml. of any of the lower alcohols: the only effect is that the end-point may fade more or less rapidly in these cases.

In the estimation of ferrous oxalate, the ferrous iron may be determined by titrating the dilute solution with potassium dichromate, provided the titration is done in a subdued light and the external indicator is also used in a subdued light. The action of light in accelerating the reduction of ferric oxalate is well known and the results therefore are likely to be high. With ceric sulphate, the ferrous iron may be found accurately in ordinary laboratory light. Thus 0.2 gm. of ferrous oxalate, dissolved in 5 ml. of 10 N sulphuric acid, with 2 ml. of concentrated phosphoric acid and diphenylamine indicator, gave per cent. Fe = 30.1. Oxidation with permanganate in acid solution, then reduction of the iron with sulphuretted hydrogen and re-oxidation with permanganate gave per cent. Fe = 30.7 and per cent. C_2O_4 = 47.6.

Estimation of Arsenic

In the titration of acidified sodium arsenite by ceric sulphate, the reaction is quite slow. The indicator is oxidised first and the arsenite afterwards, the indicator slowly decolorising and the solution becoming deep yellow. In the presence of iodine or osmic acid, however, the oxidation of the arsenite is catalysed sufficiently to make, with careful working, a normal end-point possible, and the final indicator-colour is permanent. Thus 5 ml. of arsenite solution with sulphuric and phosphoric acids and with about 0.003 gm. of osmic acid by this ceric sulphate titration gave N = 0.0984; by the usual iodometric method it gave N = 0.0983. Using instead of the osmic acid solution 1 ml. of a saturated aqueous solution of iodine (= 0.00025 gm., equivalent to 0.02 ml. of N/10 solution), then the arsenite was found to be of N = 0.0980 (no blank is allowed here for the iodine). Potassium iodate is also suitable as a catalyst for this action, but here a blank is essential, *i.e.*, the oxidising value of the iodate must be allowed for. Probably iodine is the most convenient and economical catalyst, slower than osmic acid but giving reasonable results. By this means too in a mixture of ferrous salt and arsenite, the ferrous iron may be estimated first, and then, by adding iodine, the arsenite may be found.

Estimation of Tin

Stannous chloride solutions, acidified as above with sulphuric acid, on titration with the ceric sulphate solution give a low result, *i.e.*, the indicator is oxidised before all the stannous salt; but the presence of iron salts catalyses this action so that a normal end-point is possible. Of course excess of ferric salt can be added, the solution warmed, and the ferrous equivalent of the original stannous salt can be titrated, but addition of much less ferric salt is sufficient to enable the complete oxidation of the stannous salt to be carried out by ceric solution in the cold. Thus 5 ml. of a stannous chloride solution by standard iodine solution gave N = 0.0940; by use of excess of ferric salt the ceric titration gave N = 0.0943; by the use of 1 ml. of 0.05 molar ferric sulphate solution the ceric titration gave N = 0.0940. In this last method the usual amount of sulphuric acid, 5 ml. of 10 N, was used, but no phosphoric acid. The solution becomes greenish-yellow during the titration and the end-point must be approached (as in the arsenite titration) somewhat slowly, but the end-point is permanent and may be obtained to within (say) 0.02 ml. of ceric solution. The hydrochloric acid present in the usual stannous solution, about 0.4 normal hydrochloric acid, does not interfere.

Ceric sulphate solution can be used for the estimation of ferrous salts in the presence of acids like acetic, oxalic, tartaric and citric acids, of alcohols, of cane sugar, and of acids like arsenious and phosphorous acids. Also reasonable amounts of chlorides or of hydrochloric acid do not interfere. The reagent also can be used with catalysts to estimate arsenites and stannous salts, and to carry out many oxidations that cannot be done by other oxidising agents.

* From a paper by James R. Pound, D.Sc., School of Mines, Ballarat, in *Chem. Eng. & Mining Rev.*, 1940, *32*, 383, pp. 418-9.

Antiseptic from Mould

Bactericidal Properties of Penicillin

MODERN trends in the selection of antiseptics for war-time surgery were discussed by Professor Alexander Fleming, F.R.C.S., in a recent address to the Pharmaceutical Society. The advance of the acridine dyes as first-aid antiseptics was noted, as well as the efficacy of the sulphonamide compounds as inhibitors of bacteria. A further stage in the war against the cocci is forecast in the use of penicillin, the active principle of the common mould *Penicillium*, which has proved to be four times as active as sulphathiazole (the most active of the sulphonamides) in the inhibition of the growth of hæmolytic streptococci. As yet the composition of penicillin is unknown, so that its synthesis is not possible, and its extraction from mould culture is not an economic process. Professor Fleming suggested that it might be a chemical of quite simple composition, and at any rate there is evidently a profitable field here for the ingenuity of the research chemist.

Personal Notes

MR. L. P. O'BRIEN and MR. JOHN SUTHERLAND have been appointed managing directors of B. Laporte, Ltd.

COLONEL H. C. WOODCOCK, a director of British Benzol and Coal Distillation, Ltd., has been elected Master of the Wheelwrights' Company.

MR. E. V. EVANS and MR. GORDON ADAM have been appointed by the National Gas Council as their representatives on the Grand Council of the Federation of British Industries, in connection with Group 9, Section 1 (Chemical Fertilisers and Explosives).

SIR HENRY HALLETT DALE, C.B.E., M.D., D.Sc., LL.D., Director of the National Institute of Medical Research, Hampstead, has been elected President of the Royal Society, Sir William Bragg's five-year period of office having come to an end on November 30, St. Andrew's Day.

SIR JOSEPH JOHN THOMSON, O.M., Master of Trinity College and Professor of Physics in the University of Cambridge, left £82,601. Bequests include £1,000 to the University for the Cavendish Laboratory, and his scientific books, papers, and MSS. to his son, George.

The announcement was made, just as we were going to press, that DR. FREDERICK MEASHAM LEA has been awarded 100 guineas from the Beilby Memorial Fund for his researches on silicate systems and the chemistry of cement. Dr. Lea has been distinguished for his practical chemical work since 1921, and we hope to include a short sketch of this work in our next issue.

At last Saturday's anniversary meeting of the Royal Society PROFESSOR P. M. S. BLACKETT received a Royal Medal for his work on cosmic rays. The secretary of the American Embassy received the Davy and Hughes medals on behalf of PROFESSORS UREY and A. H. COMPTON, and the Counsellor of the Swedish Legation the Rumford Medal on behalf of PROFESSOR SIEGBAHN.

The Derby gold medal has been awarded by the Council of the Liverpool Engineering Society to the late MR. L. W. SCHUSTER, of Hale, who died on July 6. The medal-winning paper, on "The relationship between the mechanical properties of materials and the liability for failure in service," was published in June, but the award was announced only a week or so ago. Mr. Schuster's work in the field of metallurgical research was of the highest importance and he had performed notable services for the Admiralty.

OBITUARY

MR. J. DALTON, for 30 years associated with the I.C.I. Alkali Works, Burn Naze, has died at the age of 56.

MR. PETER HAMILTON, chairman and managing director of William Fulton and Sons, Ltd., dyers and finishers, Paisley, died recently in Glasgow, aged 71.

MR. JOHN GEORGE DICKINSON, for half a century a chemical manufacturer at Clayton-le-Moors, died recently, aged 79. Earlier in his career he had been a director of a Birmingham chemical concern.

MR. FRANK HARRISON, for 38 years proprietor of Harrison's Chemical Works, Bootle, has died aged 78. Mr. Harrison had held executive positions in the chemical trade in this country and in South Africa.

We extend our sympathy to MR. BERNARD F. HOWARD, managing director of Howard and Sons, Ltd., Ilford, in the loss of his wife, Mrs. Bernard Howard, who died on November 23. This is the second bereavement Mr. Howard has suffered in recent weeks, his son, Mr. J. D. Howard having been killed by enemy action in October.

OIL PRICES

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users during the period December 2 to December 28.

Heroism in Chemical Works

Awards of the George Medal

ANNOUNCEMENT is made of the award of the George Medal to W. T. Beeson, officer in charge, and L. P. Fisher, fireman, both of the Works Fire Brigade at a London chemical works. When a high-explosive bomb struck a hangar where inflammables were stored, fire broke out and Beeson got his brigade to work immediately. The chief danger lay in a stock of metallic sodium which was burning and which precluded the use of water. The situation was complicated by burning liquid inflammables and clouds of fumes from a ton of chemical scattered by the bomb. Moreover, the explosives had thrown two 500 lb. cylinders of compressed ammonia gas into the seat of the fire. One of these exploded and flung burning sodium metal in all directions, besides producing a temporary gas attack. Beeson was burnt about the face, but was saved from further serious injury by the prompt action of Fisher, who got several injured men single-handed to the nearest underground shelter.

Plastics in America

U.S. Chemists Discuss Synthetic Resins

A JOINT meeting of the American Section of the Society of Chemical Industry and the American Institute of Chemical Engineers was held on November 15 at The Chemists' Club, New York City. The Chairman of the Society of Chemical Industry, Dr. Lincoln T. Work, presided.

Dr. T. F. Bradley, F.A.I.C., of the American Cyanamid Co., spoke on the chemistry of plastics. The developments in synthetic plastics in America had been far-reaching. The "resinophore" hypothesis, as well as the more abstract colloidal association hypotheses, had been supplanted by the functionality concepts of Carothers and of Kienle. These concepts and their applications to all types of plastics were discussed. Attention was called to the diversity of condensation polymers, whereas the "high molecular" class of addition polymers was at present limited to reactants which are possessed of terminal unsaturation.

Mr. C. W. Blount, of the Technical Sales Division of The Bakelite Corporation, spoke on the scope of the applications of plastics. He pointed out that each use of a plastic should be and generally was because of an outstanding property, and he noted the applications in a large number of commercial and other fields.

British Chemical Prices

Market Reports

THERE have been no outstanding changes to report this week, values throughout the market continuing steady with a firm undertone. The movement into consumption so far as heavy chemicals are concerned is of fairly substantial dimensions and elsewhere the volume of trade is good. In acids, acetic, formic and oxalic are moving well with supplies of the last-named item none too plentiful. The potash products continue firm with bichromate, and yellow prussiate in strong request and a good inquiry is reported for most of the soda products. The convention quotations for lead oxides remain unchanged. The tone in the coal tar products market is perhaps a little steadier than of late with quotations for some items such as toluol, xylol and solvent naphtha displaying a firm tendency. Interest in cresylic acid is reported to be more active and a moderate inquiry is circulating for carbolic acid crystals.

MANCHESTER.—New business on the Manchester chemical market during the past week has again been largely for early delivery, sellers as a rule not being anxious to commit themselves far forward. With hardly any exception values are firm and tend higher. So far as contract deliveries are concerned, these are on a fair scale, with users of textile chemicals in both the cotton and woollen sections calling for good supplies. In the by-products market, pyridine is again cheaper, but solvent naphtha, toluol and xylol are firm, whilst most other products are on a steady basis.

GLASGOW.—Business in the Scottish heavy chemical trade has been quiet during the past week both for home and export orders. Prices keep firm although most commodities have had to be raised to meet an increase in the railway rates.

Price Changes

Pyridine.—MANCHESTER: 14s. to 17s. per gal.

General News——From Week to Week

THE STAFF OF I.C.I. (Explosives Group), Ltd., Scotland, have contributed £315 to the Scottish Branch of the British Red Cross.

HAMMANS INDUSTRIES, LTD., have changed their address to 5-7 Regent Parade, Brighton Road, Sutton, Surrey. (Tel.: VIGilant 4472-3.)

HENRY BATH AND SONS, LTD., metal brokers, have moved their Liverpool premises to 569 Martin's Bank Building, Water Street, Liverpool, 2.

H. B. BARNARD AND SONS, LTD., metal merchants, are doing business until further notice from Minster House, 272-4 Vauxhall Bridge Road, Victoria, London, S.W.1.

DR. J. F. TOCHER, analyst to the Highland and Agricultural Society, is proposing to conduct experiments on the possibilities of utilising bracken as a source of potash.

THE MANAGERS, STAFF AND WORKPEOPLE of Turner and Newall, Ltd., asbestos manufacturers of Rochdale, have contributed £15,000 towards the purchase of aircraft.

THE DUX CHEMICAL SOLUTIONS CO., LTD., textile processors and finishers, St. Leonard's Works, Hancock Road, London, E.3, was elected a member of the Manchester Chamber of Commerce last month.

THE TREASURY HAS MADE an Order entitled "The Safeguarding of Industries (Exemption) No. 15, Order, 1940," exempting sodium potassium tartrate (Rochelle salt) from Key Industry Duty from November 28 until December 31, 1940.

AN EXHIBITION OF Plastic Materials in Everyday Objects is being held at the Manchester School of Art and remains open until December 10. The intention is to impress upon designers the wide range of uses to which plastic materials have been and can be put.

AFTER HAVING BEEN BURIED for over a month, the last body of the victims of the explosion at the works of Messrs. James Anderson and Co. (James A. Morrice), Ltd., starch manufacturers, Glasgow, has been recovered. The total death roll in the explosion is now 17.

THE SECRETARY FOR PETROLEUM, in reply to a question in the House of Commons last week, stated that considerable quantities of used lubricating oil were being reclaimed and that arrangements were being made to increase the quantity to the highest practicable level.

THE CHEMICAL SALES DEPARTMENT of the Staveley Coal and Iron Co., Ltd., have again issued their convenient diary, divided into two six-monthly parts as customary. Despite the paper shortage the amount of space available for notes of appointments, etc., is generous, and the binding is as attractive as ever.

MR. WALTER DEACON, President of the Pharmaceutical Society of Great Britain, has made a personal appeal to all members of the Society to contribute to the Society's War-Aid Fund to help pharmacists of all sorts, including students, throughout the country who have lost their businesses or their appointments because of the war.

PREMIUMS FOR WAR RISK commodity insurance became due last Tuesday. The Board of Trade reminds policy holders that payments must now be made at the new rate of 7s. 6d. a £100 a month and not 5s. a £100 a month. Those making payments will save themselves, insurance companies, and the Board of Trade time and labour if they will remember to make payment at the new rate.

THE FOOD MACHINERY EXPORT GROUP has been officially recognised by the Export Council as the Food Preparation Machinery (Miscellaneous) Export Group to represent the makers of British equipment for the manufacture, preservation, handling, storage and preparation of every type of edible product. The group's service in issuing licenses for raw materials for the exort trade is functioning smoothly, and the Ministry of Supply is allocating generous supplies of certain raw materials for the export market. These supplies are administered and certificates issued by the group. The group is anxious to make itself as complete as possible and invites applications for membership from firms manufacturing equipment under the headings indicated above. The Secretary is W. Leonard Hill, 17 Stratford Place, London, W.1. Tel.: MAYfair 7383.

BOARD OF TRADE RETURNS for October, 1940, show that imports of chemicals, drugs, dyes and colours into the United Kingdom were valued at £975,127, a decrease of £56,009 compared with the previous October. Exports were valued at £1,508,521, an increase of £410,954, while re-exports, at £24,101, showed an increase of £5,951. For the ten months ended October 31, imports increased in value by £2,061,573, to £15,097,987; exports, at £24,736,629, showed an increase of £6,601,180; and re-exports, at £545,554, showed an increase of £139,652.

Foreign News

METHYL ALCOHOL, of specific gravity not more than 0.7994 at 60 deg. F., is now duty free from all sources into Canada, when imported by manufacturers of vinyl resins.

A MYSTERIOUS EXPLOSION wrecked a building in the powder factory owned by the Du Pont company at Tacoma, Washington, on November 28. No one was injured.

ANOTHER MYSTERIOUS EXPLOSION is reported to have occurred last Monday, in the mixing plant of the Columbia Powder Co., near Tacoma, Washington. Four workmen were killed and the plant was destroyed.

THE UNITED CARBON COMPANY of Charleston, West Virginia, it is stated, is building a large new carbon black plant at Aransas Pass, near Corpus Christi, Texas. It is stated that, when ready, the plant will utilise waste gas from the adjacent refinery of the Natural Gasoline Corporation.

A NEW MANGANESE-PRODUCING CENTRE is being established in the North Urals, near Polunoch in the Ivdel Province, adjoining one of the largest manganese ore deposits in the Soviet Union. The preliminary survey for a new railway serving the manganese deposits has been completed.

SUCCESSFUL EXPERIMENTS at the "Proletarii" cement works at Novorossiisk (North Caucasus) in the production of coloured cement, have been carried out by Graehyan and Zakharov, according to reports from Russia. The cement turned out is stated to be equal in beauty to marble or granite. Raw material and equipment for its production are available on the spot.

Forthcoming Events

A MEETING of the Yorkshire Section of the Society of Chemical Industry will be held on December 9 at 5.45 p.m., in the Hotel Metropole, King Street, Leeds. The following papers have been promised: "Nylon," by G. S. J. White, I.C.I. (Dyestuffs), Ltd., Manchester, and "The Employment of Women as Laboratory Assistants," by G. B. Jones, F.I.C., A.M.I.C.E., and C. E. Randolph, B.Sc., A.I.C., of I.C.I. (Dyestuffs), Ltd., Huddersfield.

A JOINT MEETING of the Chemical Engineering Group (Society of Chemical Industry) and the Institution of Chemical Engineers will be held on December 10 at 2.30 p.m. in the rooms of the Chemical Society, Burlington House, Piccadilly, London, W.1, when a discussion on "The Salvage of Waste Materials in the Chemical Industry" will be opened by Dr. A. B. Manning, Assistant Controller of Salvage in the Ministry of Supply. The chair will be taken by the chairman of the Chemical Engineering Group, Mr. H. W. Cremer.

THE SECOND OF A SERIES of meetings of the Pharmaceutical Society, in the Society's House, 17 Bloomsbury Square, London, W.C.1, will be held on December 11 at 2.30 p.m. An address entitled "Some Nutritional Problems of War and Peace," will be given by Mr. A. L. Bacharach, M.A., F.I.C.

A MEETING OF THE Birmingham and Midland Section of the S.C.I. has been arranged to take place on December 12, in the Birmingham Chamber of Commerce Buildings, New Street, Birmingham, at 4.30 p.m. Mr. E. Taylor-Austin, F.I.C., of the British Cast Iron Research Association, will read a paper entitled "The Application of the New Lovibond Tintometer to Colorimetric Analysis." The lecture will be illustrated by slides.

THE B.B.C. ANNOUNCES that there will be a talk on "Exports," by Mr. F. L. Stevens, on December 13 at 3.30 p.m.

Metallurgical Section

December 7, 1940

THE ESTIMATION OF HYDROGEN IN STEEL—II*

Experiments with the Vacuum-Heating Apparatus

(*Continued from page 210, "The Chemical Age," Metallurgical Section, November 2.*)

THE accompanying figure is a diagrammatic sketch showing the working principles of the apparatus. The heating furnace is a fused-silica tube round the upper end of which a well-lagged nickel-chromium resistance coil is wound. This silica tube has a ground joint at its lower end, which fits a corresponding pyrex-glass tube leading to a glass mercury-vapour pump. For convenience this mercury-vapour pump is also in pyrex glass, so that from the silica-joint onwards the apparatus, through which the gas has to pass, is in one piece, the mercury-vapour and the Töpler pumps having been sealed on in position. The mercury-vapour pump is connected, via quill glass tubing, to a combined Töpler pump and McLeod gauge, the function of which is both to collect the gas and measure its quantity. The upper portion of this pump (which is called a Töpler pump for convenience) is joined to three small calibrated bulbs, isolated by taps, into which the gas collected can be compressed and its volume and pressure recorded, by taking the height of the mercury in the adjacent vertical tubing. These bulbs are graduated, the upper one being smaller than the middle one, which is itself smaller than the lower one, so that considerable variations in volume of gas can be dealt with. About seven-eighths of the gas collected is swept up and compressed by one operation of the Töpler pump, so that in order to save time in taking readings of gas quantity, only one sweep of the pump was normally taken, and the precise factor, to convert this quantity measured to the total quantity of gas given off from the specimen, was experimentally determined.

A striking feature of the apparatus is the mercury lift used to move the samples vertically in and out of the furnace. A sealed glass bulb floats upon the mercury surface in the central glass tube, and supports a long steel rod on the top of which a steel platform is attached to support the metal samples. The position of this platform together with its sample is determined by the pressure in the bottle on the right-hand side of the sketch, and out of view in the photograph (Fig. 2), since it is below the bench. Thus by a turn of the three-way tap either to the atmosphere or else to the vacuum supply, the platform can be brought to:—

(1) The level of the upper horizontal tube containing unexamined metal samples, for the purpose of a sample being magnetically pushed on the platform;

(2) the level of the centre of the furnace, near which is a thermocouple for the purpose of recording the temperature;

(3) the level of the lower horizontal tube, into which the metal sample is magnetically pushed after its heat treatment.

This mode of performing mechanical operations *in vacuo* with the aid of mercury surfaces, controlled externally, has proved itself very valuable, and superior for the present purpose to the purely magnetic control at first employed.

The experiments of others, to which reference has already been made, indicated that under certain conditions gas other than hydrogen could be given off from metals on heating, so that in the original form of this apparatus an activated-charcoal pocket was sealed in between the furnace and the mercury-vapour pump. This was employed as a quick means of determining the actual amount of hydrogen as well as the amount of other gas, since in a high vacuum charcoal does not absorb any permanent gas unless the temperature is artificially lowered, when, at the temperature of liquid air, all gases except hydrogen are absorbed. The method of examining the gas was, therefore, to measure the quantity which passed through the charcoal pocket when surrounded by liquid air; this gave the hydrogen value. Then by removing the liquid air and allowing the charcoal to warm up to room temperature, any increase in the reading corresponded to gas other than hydrogen. On several occasions the total gas collected was removed to a gas-analysis apparatus and analysed, but this was not considered a necessary part of the research, since it was hydrogen with which we were primarily concerned. Water vapour was invariably a constituent of the gas collected, unless the metal samples used were very bright and clean—and even when they came out of the apparatus brighter than then they went in. Where the quantity of water vapour was considerable, small droplets of

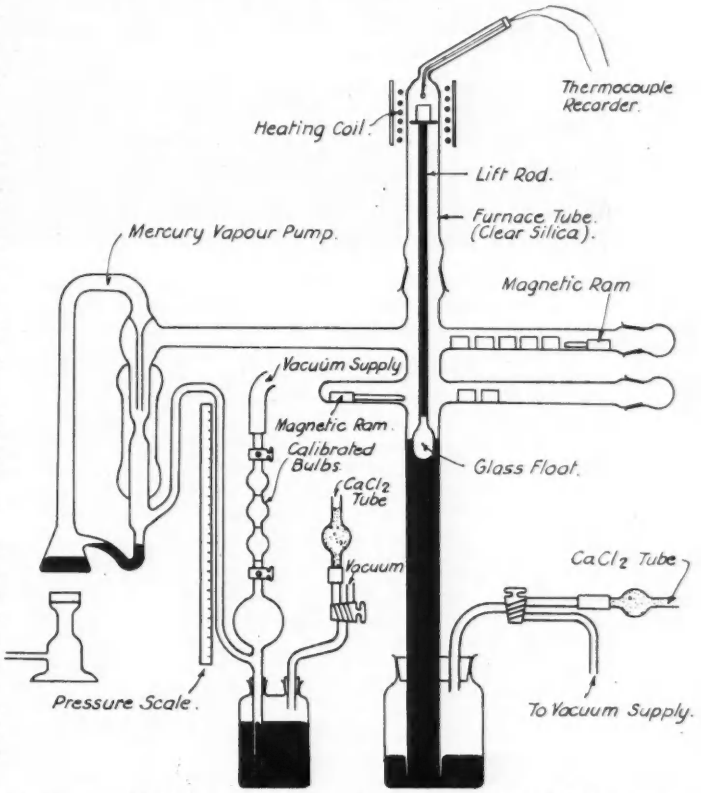

Fig. 1. Diagrammatic sketch of apparatus used for the vacuum-heating method of estimating hydrogen.

* Adapted from a paper by Dr. W. C. Newell, of the Brown-Firth Laboratories, Sheffield, presented at the summer meeting of the Iron and Steel Institute, by courtesy of whom publication is here permitted.

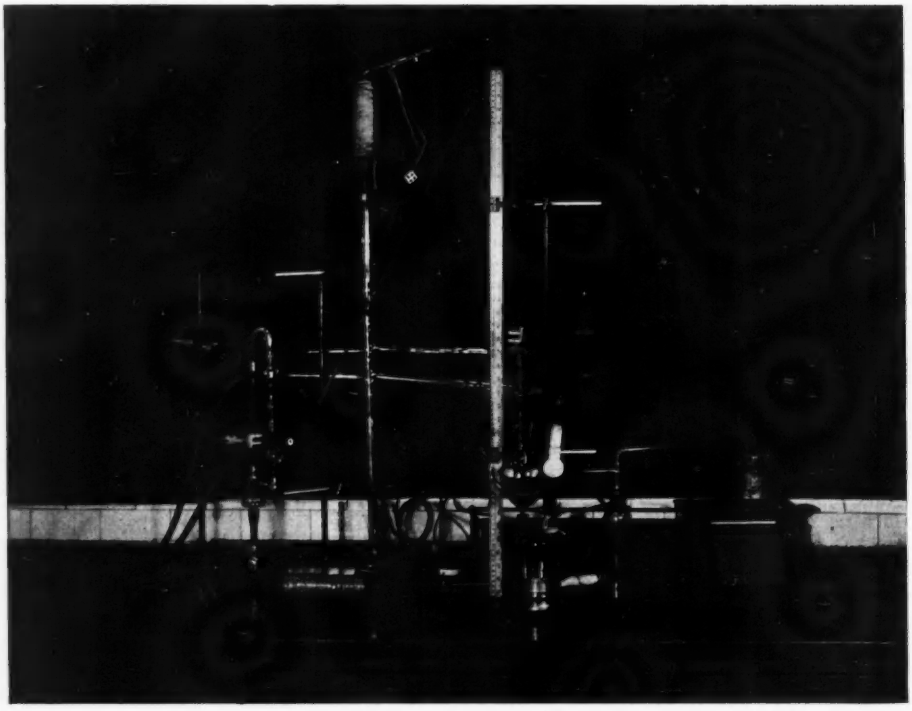

Fig. 2. Apparatus used by Dr. W. C. Newell at the Brown - Firth Research Laboratories, Sheffield, for the vacuum - heating method of estimating hydrogen in steel and other metals.

water were visible in the Töpler pump during the compression of the gas. The simplest method used for detecting water vapour, when the quantity of it present was small, was to observe the pressure of the gas when it was compressed to different stages. Any departure of the product of the pressure and the volume from being a constant indicated water vapour. Since the presence of water vapour was invariably associated with a brightening-up of the surface of the metal, it is reasonable to assume that the water vapour was produced by a reduction of an oxide film by the hydrogen being evolved from the surface. However, in such a reaction :

$$FeO + H_2 \rightarrow Fe + H_2O,$$

the volume of the water vapour formed is equal to the volume of hydrogen oxidised, so that, provided that no water is actually condensed out in the form of liquid, the volume of the system remains unaltered by the reaction. Hence all the metal samples were very carefully cleaned before examination, and the gas evolved was not unduly compressed.

Under all the conditions of study the gas given off from steel was substantially hydrogen, but at temperatures above 700° C. small amounts of carbon monoxide and nitrogen made their appearance, particularly the latter. As the temperature was raised the quantities of these gases evolved increased, and at a temperature of 1000° C. nearly 10 per cent. of the total gas was accounted for in this way. It will be noted that the apparatus was dtsigned so as to avoid contact between the metal samples and the heated silica furnace tube, since it has been suggested that oxidation of carbon from steel can take place in this way. Certainly the quantity of carbon monoxide found was small, and the most which was collected at a temperature of 1000° C. only corresponded to 0.0008 per cent. of oxygen in the steel so treated. Nitrogen was given off in somewhat larger quantities at these higher temperatures, and for the sample just referred to the nitrogen corresponded to 0.003 per cent. of nitrogen in the steel. The total nitrogen content of this steel, as shown by vacuum-fusion, was only 0.008 per cent, so that a substantial proportion had been driven off from the solid.

In an apparatus of this kind, constructed in glass and silica and having no graphite parts, the question of the "blank" really does not arise. The normal high-vacuum technique is applied in its construction, and the whole is thoroughly out-gassed before use. The furnace itself never caused any permanent evolution of gas, and that which was given off during the out-gassing period was mainly water vapour. For the sake of interest the "blank" was determined over a period of a month when the apparatus was not being otherwise used. The figure obtained came out at 0.00001 ml. per hour, and this is probably due to incomplete out-gassing rather than a leak. Hence no regard has to be taken at all for any "blank" correction.

Temperature readings were obtained by a thermocouple and recorder, the thermocouple being inserted in a narrow tube at the top of the furnace and projecting down towards the centre of the furnace. The metal sample and platform were brought up close to the thermocouple, and the uniformity of the temperature was checked by bringing the metal sample into contact with the thermocouple, when no change in the reading was observed. At the higher end of the temperature range the temperature of the thermocouple and the sample were found to be closely the same when using a disappearing-filament pyrometer.

The effect of temperature upon the rate of evolution of hydrogen was studied, using a steel sample somewhat high in the gas, since it was thought that if the gas was present in the steel in different forms, then such a study ought to give evidence of the fact. Actually no such evidence was obtained. A number of samples were cut from closely adjacent positions in an ingot, and were raised into the furnace at different temperatures, the hydrogen given off being measured at frequent intervals of time. It was found that gas was rapidly given off at temperatures above 500° C., the initial lag being reasonably accounted for as the time required for the sample to be heated. Above 900° C. the rate of evolution of hydrogen was so rapid that accurate readings could not be obtained quickly enough, whilst below 400 ° C. the rate became distinctly slow.

The conclusion of importance which was reached was that the total amount of hydrogen given off from the steel was independent of the temperature to which the steel was heated and that this amount was equal to the amount given off by vacuum-fusion. After it had been shown that no further evolution of hydrogen occurred when steel samples, which had already been vacuum-heated, were melted *in vacuo*, the conditions of extraction were standardised at 600° C. for 1

(*Concluded on page* 268.)

Metallurgical Matters in Parliament

Nickel Shipments

IN the House of Commons recently, Mr. Silkin asked the Minister of Economic Warfare whether he was aware that shipments of nickel were reaching Germany from Finland; and what action he was taking to prevent this.

Mr. Foot replied that the situation regarding the nickel mine near Petsamo, which was producing no ore at present, was under careful observation. There was no reason to believe that any shipments of nickel had reached or were reaching Germany from Finland.

Cardonnel Tinplate Works

Sir W. Jenkins asked the Minister of Supply whether he was aware that the Cardonnel Tinplate Works, Skewen, had been idle for over three months, with no suggestion of a restart, and that there was a large number of skilled men in that area unemployed; and why essential works were allowed to stay idle with skilled workers waiting to meet the needs of the country.

Mr. Harold Macmillan, in reply, said that supplies of steel were not sufficient to keep all tinplate works running to full capacity; he was afraid that the works at Cardonnel could only be reopened at the expense of employment elsewhere.

Steel Exports

Mr. Stokes asked the President of the Board of Trade whether his attention had been called to the recent increase of £2 a ton for steel; and whether he had considered the effect this increase would have on the export trade of manufactured goods, and was satisfied that no adverse effects will follow.

Mr. Harcourt Johnstone (Secretary, Department of Overseas Trade) replied that the recent increases in prices of steel had been made necessary by increases in the costs of imports from the United States of America. While such increases might sometimes have an adverse effect upon exports of goods in which the cost of steel was a large element in the total price, the exports which should chiefly be encouraged in the national interest at a time when we were importing steel from the United States of America were those of goods of high value in which the cost of raw material was a small part.

Mr. Stokes: "Is not the Minister aware that the main reason for the rise in price is imports from America? Would it not be better to subsidise the exports, and keep the price of home steel at the right level?"

Mr. Johnstone: "At the present time, when the import of steel is a very vital part of the war effort, the Government are not anxious to encourage exports in which steel as a raw material plays a dominant part. If the steel cannot carry the increased price, it is not desirable as an export."

Steel for Gas Producers

In reply to a question from Sir Stanley Reed as to what steps were being taken to accelerate the conversion of motor vehicles to the use of coal gas fuel, Mr. Grenfell stated that one of the difficulties was the question of the priority of the steel for the manufacture of the producers. A limit of 2000 had been put on in the first instance. Now it was suggested that that limit should be 10,000, and provided there had been suitable light steel alloys there would have been an expansion in the manufacture of producers. It was now possible to satisfy the prospective users that there was more fuel available than there was inside a year ago. It was now largely a question of suitable steel for the manufacture of producers.

THE MINERALS RESEARCH LABORATORY of the Union of South Africa is carrying out experiments on the production of chromates, bichromates, and chromic acid from domestic chrome.

German Zinc Resources

Valuable Acquisitions in Silesia

OUTSTANDING among the zinc-producing regions of the Old Reich recording marked gains in production in recent years is the Rammelsberg district, near Goslar, in the lower Harz Mountains. Production in this region has been quadrupled as a result of the installation of a large modern flotation plant that makes possible the treatment of extremely finely mixed lead-zinc ore by selective flotation, and also as a result of the construction of a new zinc smelter at Harlingerode operating the New Jersey process, together with a modernisation of other already existing plants. By the introduction of new processes and the sinking of a new shaft, productive capacity of the mines has been greatly expanded. As a result, the lower Harz has developed into one of the leading zinc-producing centres of the world, with prospects of sustained production on a large scale for an extended period.

Mines in the Rhein-Lahn district operated by the Stolberger Zink A.G. have been enlarged greatly since 1936 by conversion of the old-style ore dressing at Bad Ems to the all-flotation system and further extensive development of a central ore-dressing plant with daily charge of 1150 metric tons. Output in the Ramsbeck Basin has been expanded by the establishment of an all-flotation plant and other plant enlargements. The extent of the production expansion in the Rhineland is indicated by the fact that in 1932 only eight lead and zinc mines were in operation in the Bonn district and furnished 64,000 tons of concentrate; in 1938, 20 mines were working, with a total productive capacity of 178,000 tons of concentrate. Exploitation has been undertaken of the lead-zinc deposits in the Gewerkschaft Auguste Viktoria field, near Hüls in the Westphalian industrial region, where extensive ore reserves with a metal content of 9 per cent. lead-zinc were discovered.

Germany's supply of zinc has also been expanded by the processing of sulphur pyrites containing 7 to 8 per cent. zinc from deposits in the Meggen district, where a large flotation plant has been installed. The incorporation of Austria furnished Germany with the output of the lead-zinc mines at Bleiberg-Kreuth in Carinthia. Production plants in Baden, which had been idle from 1931 to 1936, have been brought into operation and their capacity enlarged by the sinking of new shafts and construction of a new flotation plant. The most important development, however, has been the acquisition of the deposits in eastern Upper Silesia. Polish zinc-ore output in 1938 was about 500,000 metric tons, equivalent to 20 per cent. of Greater Germany's production, but, owing to the richness of the ore, equalled 41 per cent. of the lead and zinc production. From 1929 to 1938 output of the lead-zinc industry in Upper Silesia declined 33 per cent. Although Poland produced 111,000 tons of zinc in 1938, only 70,000 tons came from domestic ore. (Mineral Trade Notes, U.S. Bureau of Mines, 1940, *2*, 4, p. 14).

ACCORDING TO THE *Wall Street Journal*, copper for national defence requirements may probably soon be imported into the United States from South American mines. Demands in September and October resulted in record-breaking sales and consumption. The trade points out that the 4 per cent. import tax would not be effective on copper imported by a Government agency, which could hold the metal as an emergency reserve and release it to consumers as the demand arose. Normally, the United States exports about half its own copper production. In 1939, production totalled 666,783 metric tons, of which about 372,665 short tons were exported.

THE MINERALS YEARBOOK 1940, published by the U.S. Department of the Interior, Bureau of Mines, price $2, includes a survey of the bituminous coal industry, furnished by the National Bituminous Coal Division. An enlarged chapter presents the results of an expanded survey of non-ferrous secondary metals, and complete final statistics for 1939 are presented with the exception of the chapters on bituminous coal, petroleum, natural gas, and natural gasoline, and these chapters contain adequate reviews based on preliminary data.

Duralumin Alloys

Test for Corrosion Characteristics

DURALUMIN alloys are susceptible to two types of corrosion. Corrosive attack may follow the crystal boundaries of the metal and thus seriously reduce its strength and resistance to shock. On the other hand, material of the same composition that has been given a different heat treatment may be susceptible only to the pitting type of attack, which is generally less damaging to the strength of the alloy than the intercrystalline type. The customary method of determining the type of attack that may develop in duralumin is to immerse the material for several hours in a solution that accelerates corrosion, and then to examine the sample with a metallographic microscope. This method takes time and destroys the sample. There is a need for a rapid, non-destructive test to determine whether, for example, the metal in the wing-covering of an aeroplane is susceptible to intercrystalline corrosion.

Because the electrochemical potential of duralumin in a salt solution is different for similar samples that have been given different heat treatments, the measurement of these potentials has been suggested by the U.S. National Bureau of Standards as a means of predicting the type of corrosion that may occur. To determine the reliability of such predictions, Hugh L. Logan has measured the potentials of many samples of material, some known to be susceptible only to pitting, and others known to be susceptible to intercrystalline corrosion. In the *Journal of Research* for September (RP 1328), it is shown that samples having potentials more negative than −0.057 volt, against a saturated calomel electrode, were generally susceptible to intercrystalline corrosion. Conversely, materials having less negative potentials were generally immune to intercrystalline corrosion and susceptible only to pitting. As the test method is delicate and requires a trained operator, it is primarily for use in the laboratory and not in the shop.

Vanadium in Germany

National Cartel Formed

GERMAN production of vanadium from blast-furnace slag has increased greatly since the outbreak of the war, according to a consular report published by the U.S. Bureau of Mines, so that virtually all requirements can be supplied domestically. Until a few years ago, Germany was dependent upon imports from Peru, the United States, and East Africa, these imports requiring outlays of foreign exchange amounting to several million marks annually. Efforts to produce vanadium in 1914-18 proved uneconomic, but improved processes developed since make it possible to obtain vanadium from blast-furnace slag at not prohibitive cost. A national cartel, Vanadium G.m.b.H., comprising three producing companies—I.G. Farbenindustrie, Gesellschaft für Electrometallurgie (an affiliate of the Metallgesellschaft), and the Otavi Minen Gesellschaft—is entrusted with supplying German requirements of vanadium. The Reichs Price Control Commissar recently authorised the I.G., following its incorporation into the cartel, to increase its price of vanadium by 50 pf. per kg. for such a period as might be required to compensate the company for the 395,000 marks paid for research and development work preceding its production of vanadium.

(*Continued from page* 266.)

hour. These conditions have been proved satisfactory for many different types of steel, but occasionally it is found that hydrogen is still being very slowly evolved after the period of 1 hour. If this occurs, then the period of heating is extended, maybe to 2 hours or more, until a constant value is obtained. No explanation of this effect can as yet be given, though it is thought to be possibly related to the influence of the structure of the steel upon the diffusion of hydrogen.

New Control Orders

Iron and Steel Exports

THE Board of Trade has made the Export of Goods (Control) (No. 37) Order which came into force on November 7, by which licences will be required to export to any destination certain manufactures of iron and steel (including alloy steel), comprising hoop and strip and plates and sheets of all kinds, and various specified types of fabricated iron and steel goods.

Iron and Steel Maximum Prices

The Minister of Supply has made the Control of Iron and Steel (No. 13) Order, 1940, under which new maximum prices for iron and steel products are instituted and those laid down in the Control of Iron and Steel (Nos. 8-12) Orders are withdrawn. The new maximum prices represent an increase of 35s. a ton on billets, sections, joists and rails, and of £2 a ton on plates, with corresponding adjustments in the prices of finished products such as tubes, bolts and nuts and wire.

The greater part of these advances in price is to meet payments into a Central Fund which is used to equalise the cost of imported steel and raw materials with the price of similar home products. In particular, the need to augment the Central Fund is the result of the increasing quantities of imported steel now arriving from the United States. Some allowance, amounting to about 5 per cent. on present prices, has been made to meet certain increases in home production costs.

New Standards for Alloys

Ferro-Manganese and Stainless Steel

BUREAU of Analysed Samples, Ltd., announces the following new analytically standardised samples:—

B.C.S. Ferro-Manganese No. 208.

	per cent.		per cent.
Manganese	78.00	Arsenic	0.027
Iron	13.37	Titanium	0.082
Carbon	6.58	Copper	0.025
Silicon	1.27	Ni, Co, V	traces
Sulphur	0.014	Cr, Al, Mo	,, ,,
Phosphorus	0.237	Oxygen	by diff.

B.C.S. Stainless Steel No. 209.

	per cent.		per cent.
Chromium	18.70	Silicon	0.19
Nickel	8.30	Sulphur	0.029
Titanium	0.59	Phosphorus	0.019
Carbon	0.11	Manganese	0.39

Ferro-Manganese No. 208 is typical of the type manufactured in blast-furnaces in this country and is particularly useful as a standard for manganese and phosphorus. The accurate determination of phosphorus in ferro-manganese calls for certain precautions peculiar to this type of alloy. Details will be found on the certificate of analyses.

Stainless Steel No. 209 is of the 18:8 type incorporating titanium. The certificate of analyses includes modern methods for Cr, Ti, and Mn.

Each sample has been analysed by experienced chemists representing well-known manufacturers as well as by independent chemists and users, including (in the case of stainless steel) the Ministry of Aircraft Production. Each bottle of standard material will be provided with a certificate of analyses showing each co-operating chemist's figures including an outline of his methods of analysis. Supplies may be obtained from Bureau of Analysed Samples, Ltd., Markington, Harrogate (Tel.: Bishop Monkton 36), or through the usual laboratory furnishers.

British Association of Chemists

Annual General Meeting

THE 23rd annual general meeting of the British Association of Chemists was held at the Manchester College of Technology last Saturday, Mr. A. J. C. Cosbie, Chairman of Council, presiding. Mr. C. S. Garland, Past-President, presented the financial report in the absence of Mr. Woodcock, the treasurer. The accounts of the year's working again showed a balance in hand and the Unemployment Insurance Fund had accumulated a reserve fund of £22,000.

The Chairman, presenting the annual report, announced that the nett increase in membership was 152, an extremely satisfactory indication of the Association's progress, having regard to the high standard required for membership. The appointments service and the legal aid department had, as usual, done excellent work. Perhaps the most important step forward during the year was the appointment of the association as the agent of the Ministry of Labour in connection with unemployment insurance of chemists. This meant that every chemist, and in particular those younger men with a salary of less than £420 per annum, would find membership of the B.A.C. almost indispensable. Already there had been a very large number of inquiries concerning this question of professional and compulsory insurance.

Miss W. Wright presented the report of the Unemployment Special Purposes Committee, of which she is chairman. She alluded to the great service which Mr. J. B. P. Harrison had rendered to the committee as its chairman. The increased benefit of 2s. 6d. per unit after five years' continuous subscription was to be continued. Miss Wright also referred to the importance of the arrangement with the Ministry of Labour whereby the association was to administer compulsory insurance on behalf of chemists. It was necessary that they should contract in immediately and sign the form of contract stating that insurance was to be paid through the B.A.C.

The following honorary officers were proposed and elected to serve for the ensuing year: President: Professor F. G. Donnan, C.B.E., F.R.S., M.A., F.I.C.; registrars: Professor E. C. C. Baly, C.B.E., F.R.S., F.I.C.; treasurer: W. H. Woodcock; editors, H. T. F. Rhodes, M.I.E.I., and J. P. Lawrie.

The resolution was then proposed "that the British Association of Chemists should join the National Joint Committee for Scientific Technical and Engineering Supervisory Staffs, and support it by every possible means." Mr. Dooley supported the resolution and Mr Baker proposed an amendment "that the British Association of Chemists should co-operate with any national organisation which, in the opinion of Council, can advance the economic or professional interests of British chemists." Mr. F. Scholefield said that, as an old member of the association, he must warn the meeting against steps which might dissipate the association's energies. Schemes of this kind had been attempted in the past and had proved unworkable. The amendment, however, was put to the vote by the chairman, and carried by a large majority.

Prior to the meeting a lunch was held at the Manchester College of Technology. Mr. Cosbie presided and Dr. Walker of the college and Mr. Heap, Public Analyst of the City, were present as guests.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Applications for Patents

POLYMERISATION OF CONJUGATED DIOLEFINIC HYDROCARBONS to drying polymers.—E. I. du Pont de Nemours and Co. (United States, Oct. 4, '39.) 14909.

PICKLING TREATMENT OF METALS, ETC.—A. R. Gibson and Electro-Chemical Engineering Co., Ltd. 14838.

DRYING OF CELLULOSE FILM.—G. S. Heaven and H. S. Heaven. 14983.

MANUFACTURE AND DRYING OF CELLULOSIC FILM.—G. S. Heaven, L. Jefferies and H. S. Heaven. 14982.

MANUFACTURE OF AZO DYESTUFFS.—Imperial Chemical Industries, Ltd. (Du Pont de Nemours and Co.). 14908.

MANUFACTURE OF TETRAKISAZO DYESTUFFS.—Imperial Chemical Industries, Ltd. 14910.

BITUMINOUS THERMOPLASTIC PRINTING INKS.—Interchemical Corporation. (Nov. 24, '39.) (United States, Dec. 8, '38.) 15021.

ROSIN SIZE EMULSIONS.—L. Mellersh-Jackson (Hercules Powder Co.). 15063.

PRODUCTION OF THERAPEUTICALLY-ACTIVE DERIVATIVES of 4, 4'-diaminodiphenyl sulphone.—E. Lilly and Co., M. S. Kharasch, and O. Reinmuth. 14892.

ANTHRAQUINONE COMPOUNDS.—F. Lodge, A. Lowe, W. W. Tatum, and Imperial Chemical Industries, Ltd. 15012.

ESTERS AND THEIR SULPHONATED DERIVATIVES.—National Oil Products Co. (United States, Sept. 30, '39.) 15069.

ETHERS AND THEIR SULPHONATED DERIVATIVES.—National Oil Products Co. (United States, Sept. 30, '39.) 15070.

METHOD OF POLYMERISING UNSATURATED METHYLENE COMPOUNDS. Norton Grinding Wheel Co., Ltd. (United States, Oct. 6, '39.) 14972.

PRODUCTION OF RESINOUS PRODUCTS.—Polyxor Chemical Co., Inc. (United States, Oct. 24, '39.) 15058.

PURIFICATION OF HYDROGEN GAS.—Power-Gas Corporation, Ltd., N. E. Rambush and A. T. Grisenthwaite. 14875.

TREATMENT OF OIL.—A. Roberts. 15006.

PRODUCTION OF GERMICIDAL AEROSOLS.—T. L. Shepherd and A. H. Baker. 14952.

PROCESS AND APPARATUS for the purification of anthracene.—T. O. Wilton, E. H. Priest, and Chemical Engineering and Wiltons' Patent Furnace Co., Ltd. 15056.

Complete Specifications Open to Public Inspection

OIL PURIFYING SYSTEM.—Trico Products Corporation. April 1, 1939. 25342/39.

RECOVERY OF ALUMINIUM FROM WASTE.—W. De Keyser. Jan. 18, 1939. 322/40.

METHOD OF PREPARING MELAMINE.—American Cyanamid Co. April 4, 1939. 1558/40.

PRODUCTION OF SOLUTIONS containing water-soluble resins.—Corn Products Refining Co. March 18, 1939. 3069/40.

PROCESS FOR REFINING HYDROCARBON OILS.—N. V. de Bataafsche Petroleum Maatschappij. April 3, 1939. 3322/40.

PROCESS FOR THE PRODUCTION of colourless or light-coloured sulphonium compounds.—N. V. de Bataafsche Petroleum Maatschappij. April 3, 1939. 4516/40.

APPARATUS FOR THE CATALYTIC CRACKING OF HYDROCARBON OILS. Standard Oil Development Co. April 1, 1939. 5087/40.

PANTOTHENIC ACID.—Merck and Co., Inc. April 3, 1939. 5484/40.

MANUFACTURE OF 17-VINYL-TESTOSTERONE, or enol derivatives thereof.—Soc. of Chemical Industry in Basle. April 1, 1939. (Cognate Application 5506/40.) 5505/40.

Complete Specifications Accepted

PRODUCTION OF VALUABLE ORGANIC PRODUCTS of high molecular weight.—J. G. Fife (N.V. de Bataafsche Petroleum Maatschappij). December 19, 1938. (Cognate Applications, 15971/39 and 32189/39.) 527,075.

MANUFACTURE AND APPLICATION OF CONDENSATION PRODUCTS.—Soc. of Chemical Industry in Basle. January 22, 1938. (Cognate Applications, 2128/39 and 2130/39.) (Sample furnished.) 527,012.

MANUFACTURE OF ACTIVATED CARBON.—Trinidad Leaseholds, Ltd. (A. G. V. Berry, K. H. Cheetham and Trinidad Leaseholds, Ltd.). February 1, 1939. 527,213.

APPARATUS FOR GASIFYING TOXIC MATERIAL for the sterilisation of stored products.—Gaso Esterilisadora Limitada. February 26, 1938. 527,077.

BASIC REFRACTORY MATERIALS.—P. Imbert, L. Veaux, and P. Pallier. March 28, 1939. 527,024.

UREA-ALDEHYDE CONDENSATION PRODUCTS.—Bakelite Ges. April 5, 1938. (Addition to 479,250.) 527,029.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

PAUL QUINN, LTD., London, E.C., paint manufacturers. (M., 7/12/40.) November 12, £5000 debentures, part of a series already registered. *——. April 23, 1940.

XELEX PRODUCTS, LTD., London, W., dealers in raw plastic material. (M., 7/12/40.) November 8, £125 debentures, part of a series already registered.

Satisfactions

A. AND E. PEARS, LTD., Isleworth, soap manufacturers. (M.S., 7/12/40.) Satisfaction November 11, £120, part of amount outstanding July 1, 1908.

BRITISH CELANESE, LTD., Torquay. (M.S., 7/12/40.) Satisfaction November 15, of debenture stock registered June 21, 1934, to extent of £58,159.

County Court Judgments

ARTHUR BOSTOCK, 4 Baker Road, Weston Point, Cheshire, chemical worker. (C.C.J., 7/12/40.) £18 3s. 0d. September 24.

COLE BRYANT AND CO. (a firm), Western-ho, Midland Road, Bristol, oil and grease merchants. (C.C.J., 7/12/40.) £13 17s. 2d. October 1.

Receiverships

JEK, LTD. (R., 7/12/40.) Manufacturers of and dealers in wood preservatives and belt dressings, etc. Unicorn Wharf, Dacre Road, Old Ford, E.3. C. H. Pridden, of 75 Pepys Road, New Cross, S.E., was appointed receiver and manager on November 4, under powers contained in debenture dated November 14, 1939.

Companies Winding-Up Voluntarily

LITTLE WENLOCK CLAY MINES, LTD. (C.W.U.V., 7/12/40). That the company be wound up voluntarily. Cecil William George 7 Priory Street, Dudley, Worcester, appointed liquidator.

CONDENSED GAS COMPANY, LTD. (C.W.U.V., 7/12/40). General meeting of members at Grosvenor House, Park Lane, London, W.1., on Monday, December 30, 1940, at three p.m.

Chemical Trade Inquiries

Australia and New Zealand.—A firm of agents established at Sydney wishes to obtain the representation, on a commission basis, of U.K. manufacturers of moulding powder, dyes, carbon black. (Ref. No. 552).

Company News

British Alkaloids, Ltd., announce an interim dividend of 12 per cent. less tax, on ordinary shares (same).

Lewis Berger and Co., Ltd., announce a final dividend of 7 per cent., less tax, making 13 per cent. for the year. Profits £165,734 (against £156,416).

Lautaro Nitrate Co., Ltd., announce a final interest payment of 2½ per cent., making 4 per cent. for year, on first mortgage income debenture stock and first mortgage (Antofagasta) income debenture stock.

The Kern Oil Co., Ltd., announces a dividend of 8 per cent., less tax, for the year ended May 31, 1940. This dividend is at the same rate as for the previous year, but is payable on the capital as increased by £100,000.

United Match Industries announce that preliminary figures show profit for the year to October 31 amounting to £16,225 (last year £15,610). Dividend of 50 per cent., less tax (same), will be paid on the deferred ordinary shares.

British Benzoi and Coal Distillation, Ltd., recommend a final dividend of 5 per cent., together with a bonus of 5 per cent., both subject to tax at 8s. 6d., to be paid on December 31. This makes 15 per cent. for the year to October 31 (same).

The Chilean Nitrate and Iodine Sales Corporation announce through Glyn, Mills and Co., British trustees, that half-yearly interest payment on 5 per cent. sterling income debentures will be made on December 31 at full rate of 2½ per cent. (less income tax).

New Companies Registered

Edible Fat Refinery, Ltd. (362,090).—Private company. Capital, £2500 in 2500 shares of £1 each. Manufacturers, extractors, maltsers, refiners, blenders and importers of and wholesale and retail dealers in edible and other fats, greases, bones, oils, emulsions, etc. Directors: John K. Forsey, John N. Forsey, J. K. Forsey is permanent managing director. Secretary: John K. Forsey. Registered Office: Wolvershill, Banwell, Somerset.

Petroleum Inventions and Specialities, Ltd. (363,972).—Private company. Capital, £1000 in 1000 shares of £1 each. Manufacturers of and dealers in petroleum products, derivatives, compounds and addition agents, chemicals, gases, drugs, medicines, gypsum, plasters, disinfectants, fertilisers, lubricants, oils, dyes, soap, etc. Subscribers: Frank Wheatcroft, 20 Leegate Road, Heaton Moor, Stockport: Albert E. Metcalfe.

Jesse Shirley and Son, Ltd. (364,140).—Private company. Capital, £16,000 in 16,000 shares of £1 each. To take over the business of a manufacturer of bone products and fertilisers, and a bone and flint miller, carried on by Jesse W. Shirley at Etruria, Stoke-on-Trent, as "Jesse Shirley and Son." Directors: Jesse W. Shirley, The Hill, Sandy Lane, Newcastle, Staffs (permanent director and chairman), Mrs. Annie M. L. Shirley. Solicitors: Llewellyn and Son, Tunstall.

Ian N. Merrill and Co., Ltd. (364,009).—Private company. Capital, £1000 in 1000 shares of £1 each. Chemical engineers, sterilisers, dyers, cleaners, makers of and dealers in chemical plant, nurses' outfitters, laboratory proprietors, charcoal manufacturers, mechanical, electrical and general engineers, etc. Directors: Ian Nuttall Merrill and Ivy M. Merrill, both of 16 Egbert Road, Totley Rise, Sheffield. Ian N. Merrill is permanent managing director subject to holding 100 shares.

Chemical and Allied Stocks and Shares

BUSINESS on the Stock Exchange has centred on Government securities, and in other departments inactive conditions have ruled, although the undertone in industrial shares was fairly steady. Financial results that have come to hand have continued to create a satisfactory impression, although they, of course, reflect the high level of taxation. The figures of some companies in the heavy industries appear to indicate a sharp fall in the margin of profit owing to increased cost of materials and other factors arising from the war.

Among securities of companies associated with the chemical and kindred trades, Turner and Newall were again favoured and have further improved to 67s. 6d., which compares with 66s. 10½d. a week ago. Imperial Chemical showed small fluctuations, but at 28s. 3d. were unchanged on balance, but the preference units were 3d. better at 31s. 6d. Lever and Unilever were slightly better at 24s., but British Aluminium eased to 41s. 10½d. and British Oxygen were lower at 64s. 4½d. Distillers ordinary units lost part of their recent improvement, but are 64s. at the time of writing, there being general confidence in the market that the forthcoming interim dividend is likely to be maintained. Goodlass Wall and Lead Industries 10s. ordinary shares improved, and were quoted around par, which compares with 9s. 6d. a week ago. On the other hand, following their recent improvement, Borax Consolidated deferred units eased to 26s. 3d.

There was a slightly easier trend in cement shares, and Associated Cement were 59s. 4½d. Demand for cement is generally expected to remain at a high level for some time ahead, but the margin of profit may be reduced, if, as is being suggested in some quarters, special war-time measures become necessary for increasing output. After easing to 11s. 10½d. on disappointment with the interim payment, British Plaster Board rallied to 12s. 3d.xd. Sentiment in regard to iron and steel shares continued to be influenced by the reduced net profits shown by recently-issued results. Dorman Long ordinary and Baldwins were slightly lower in price. On the other hand, Stewarts and Lloyds were better at 40s. 3d. and Tube Investments were firm at 86s. 3d. on the market view that the company appears to have reasonably good prospects of maintaining its dividend for the financial year 1940-41. United Steel were 20s. 10½d. and Consett Iron 6s. 8d. shares were quoted at 6s. 4½d. Allied Ironfounders were lower at 12s. 6d. General Refractories remained steady at 7s., but Imperial Smelting were easier at 10s. Shares of the International Combustion Co. continued to be firmly held, awaiting the dividend announcement.

Courtaulds improved to 30s. 3d., while British Celanese issues were steady pending publication of the financial results. Pinchin Johnson were lower at 18s. 3d., but International Paint were steady, and Lewis Berger remained around 36s. on the figures for the past financial year. Wall Paper Manufacturers deferred units were higher at 20s., while elsewhere, United Molasses made the better price of 22s. 3d. Michael Nairn were maintained at 45s., but Barry and Staines reacted further to 25s. 7½d. in view of the recent interim dividend decision. Triplex Glass were lower at 17s. 9d. In other directions, Boots Drug eased to 39s., but Sangers were better at 19s. 3d., while Timothy Whites were 19s. 9d., British Drug Houses were 22s. 6d. B. Laporte 50s. and Greeff-Chemical 5s., shares 5s. 6d. Leading oil shares were lower on balance for the week.